Lehmannaudio®

Linear

Headphone amplifier / Single Source Preamp

User manual

Dear customer,

congratulations for buying the **Lehmann***audio* Linear. You will be rewarded with the best possible sound from your headphones. You can use practically all dynamic headphones on the market. Carefully selected components and a highly sophisticated circuit design guarantee a very high level of audio reproduction.

Please read this manual carefully and keep it nearby the unit for future reference even if you have experiences with other headphone amplifiers!

Precautions

Please read the following before operating your Linear.

While installing the Linear

- Be careful to use an appropriate cable for the connection between your power outlet and the Linear. Make sure that you have the appropriate version for your mains voltage.

- Be careful to prevent Linear from getting wet; do not allow water to enter the unit, especially when raining or snowing, or near a body of water. Otherwise fire or electrical shock may result.

- Do not place heavy objects on the power cord. If the cord is damaged, fire or electrical shock may result. In particular, it is possible that one might accidentally place a heavy object on a carpet that covers the cord; definitely avoid these situations!

- Do not install the Linear in a place where it might be exposed to oil, smoke or steam (for example, near a cooking table or humidifier). Otherwise, fire or electrical shock may result.

- Do not place the Linear on an unstable surface, such as an unstable bench or slanted surface. Otherwise, the device may fall or drop, resulting in an injury.

- Do not place the power cord near a heating device. Otherwise, the cord sheath may melt, resulting in fire or electrical shock.

- Do not locate the Linear in a place subject to excessive heat, such as inside a car with all the windows closed, or in direct sunlight. Otherwise, fire may result.

- Do not handle the power plug with wet hands. Otherwise you may receive an electrical shock.

- When you remove the power plug, be sure to hold the plug. Never pull on the cord. Otherwise, the power cord may become damaged, resulting in fire or electrical shock.

- The Linear offers superb sonic quality. To ensure best possible results, you should use the best quality connecting cables that you can afford. Regular maintenance involves keeping all connections clean using a quality contact cleaner.

Using the Linear

Do not touch the Linear under the following circumstances:

- If you hear thunder, remove the power plug from the AC outlet as soon as possible. If you fear a lightning hit and the Linear has been connected to an AC outlet, do not touch the power plug. Otherwise you may receive an electrical shock.

- Do not attempt to modify this equipment. Otherwise, fire or electrical shock may result. Warranty is void on modified devices.

- If you think the Linear needs to be checked for maintenance or repair, consult your dealer.

- Do not place a container of water or any small metal object on top of the Linear. If water is spilled or if the metal object gets inside, fire or electrical shock may result. This applies to vases, potted plants, glasses, cosmetic bottles, medicine, etc.

- Do not damage, process, bend, twist, stretch or heat the power cord. If the cord is damaged, fire or electrical shock may result.

- When you are connecting other audio devices to the Linear make sure that you first turn off the power to all devices to be connected. Refer to the user´s guide for each device and use the specific cable for connection.

- Set the volume levels of all devices (including that of the Linear) to minimum before connecting the Linear to your actual setup and to the AC outlet. Otherwise, an extremely loud noise could damage your loudspeakers or even your hearing.

- If you plan not to use the Linear for a long period of time (such as when you are on vacation), remove the power plug from the AC outlet. Otherwise, a fire could possibly result.

If any abnormality occurs while using the Linear, remove the plug from the AC outlet. In this case first shut off the power amplifiers or turn down the volume controls and so on to avoid possibly damaging transients

- If you notice any abnormality - such as smoke, smell, noise, etc. - remove the plug from the AC outlet. Confirm that the abnormality is no longer present, then consult your dealer for repair. If you continue using the Linear under abnormal conditions, fire or electrical shock may result.

- If a foreign object or water enters inside the equipment, remove the Plug from the AC outlet and consult your dealer for repair. If you continue using the Linear under this condition, fire or electrical shock may result.

- If the power cord is damaged (for example if it is cut or if the core wire is exposed), ask your dealer for a replacement. If you continue using the Linear under this conditions, fire or electrical shock may result.

- If the Linear is dropped, or if the case is damaged, remove the plug from the AC outlet and consult your dealer. If you continue using the Black Cube under abnormal conditions, fire or electrical shock may result.

Maintenance

- Before cleaning the Linear remove the power plug from the AC outlet for safety. Otherwise, an electrical shock may result.

- Do not open the Linear. There are hazardous voltages inside that might result in an injury or an electrical shock.

Why headphones?

When you use headphones you can reach a very high level of sound reproduction at a fraction of the price you would have to spend for a regular hifi setup with high quality loudspeakers. Detail resolution and dynamics of even the best loudspeakers can easily be reached with the best headphones. In most cases headphones will be used to enjoy music either to acoustically disclose a noisy environment to just to be able to listen to louder levels without disturbing other people.

What makes headphones different?

There is a number of parallels between (dynamic) headphones and loudspeakers. Technically they are complex loads for the amplifiers driving them and should therefore be used with stable outputs. There are headphones with higher impedance that need a higher signal voltage and low impedance types which need more current for optimal sonic results. Just connecting a headphone to any given headphone output without considering the headphone's electrical characteristics will most likely yield dissatisfactory results.

Impedances of dynamic headphones can vary from 30 Ohms to 600 Ohms. Transferred to loudspeakers this would result in impedances from 4 Ohms to 80 Ohms. The same signal amplitude results in a power consumption difference of factor 20!

Loudspeakers and headphones are manufactured in a dazzling variety. Irrespective of their impedance headphones and loudspeakers can have very different efficiencies which means that the electrical signal is converted more or less effective to acoustic energy. When comparing loudspeakers the dimension used is the sound pressure level (SPL) reached at a given power of 1W (at 1m distance). There is a similar parameter for the efficiency of headphones except for the fact that the standard power is 1mw (=1/1000W) The figure is given as dB/mW which means the resulting sound pressure level *at* 1mW (not *per* 1mW).

If the power is doubled then the resulting sound pressure level is 3dB higher. If this is calculated the other way round it means that only half of the power is needed when using a headphone with 3dB more efficiency to reach the same sound pressure level. The 3dB formula is valid for headphones and for loudspeakers.

From the given efficiency the power needed for a certain sound pressure level can be derived. The power for the same sound pressure level can differ up to a factor of 500 for the different headphones on the market. In the end what counts when selecting a headphone or a headphone amplifier is if the desired volume can be reached without distortion. At least equally important is to avoid damage for the headphone and – most important – to avoid damage for your hearing. The maximum power rating is a figure that can be found in the data sheet of the headphone. From this power rating the maximum voltage can be derived. If the voltage will be higher then the voice coils of the headphones will be destroyed. Today most headphones allow hearing levels well above a secure level for the listener. This means that a standard pair of cans might survive extremely high levels without any degradation of long term performance but the hearing of the listener might be seriously damaged. Especially interesting are the standards of different regions.

Taking a look at laws in the US and in Europe reveals tremendous differences in what is thought to be suitable for the listener:

Permissible noise exposures in Germany (dBA)[1]

SPL /dBA Duration	85	88	91	94	97	100	103	106	109	112	115	118	121
hours per day	8	4	2	1									
minutes per day					30	15	7,5						
seconds per day								225	112	56	28	14	7

Permissible noise exposures in the USA (dBA)[2]

SPL /dBA Duration	90	92	95	97	100	102	105	110	115
hours per day	8	6	4	3	2	1,5	1		
minutes per day								30	15

[1] Roughly harmonized throughout Europe

[2] Figures taken from US department of labour noise regulations

Overview of power consumption of different headphones at different signal levels:

level (v_{eff})	Headphone impedances				
	32 Ohms	*60 Ohms*	*120 Ohms*	*300 Ohms*	*600 Ohms*
0,1V	0,31mW	0,16mW	0,08mW	0,033mW	0,016mV
0,5V	7,8mW	4,2mW	2,1mW	0,83mW	0,42mW
1V	31,3mW	16,7mW	8,3mW	3,3mW	1,7mW
2V	125mW	66,7mW	33,3mW	13,3mW	6,7mW
3V	281mW	150mW	75mW	30mW	15mW
4V	500mW	267mW	133mW	53mW	27mW
5V	781mW	420mW	210mW	83mW	42mW
6V	1,13W	600mW	300mW	120mW	60mW
7V	1,53W	817mW	408mW	163mW	82mW
8V	2W	1,06W	533mW	213mW	107mW
9V	2,53W	1,35W	680mW	270mW	135mW

Voltage needed for 1mW power

units	Headphone impedances				
	32 Ohms	*60 Ohms*	*120 Ohms*	*300 Ohms*	*600 Ohms*
Volts	179mV	245mV	347mV	550mV	775mV
dBu (odB = 775mV)	-12,7	-10	-7	-3	0
dBV (odB = 1V)	-14,9	-12,2	-9,2	-5,2	-2,2

Table of effectivity of common headphones[3]

Type	Impedance /Ohms	Efficiency dB/1mW	Voltage for 100dB SPL	Power for 100dB SPL
AKG				
K141Studio	55	101	209mV	0,8mW
K240DF	600	88	3,1V	16mW
K501	120	94	694mV	4mW
K1000	120	74	6,93V	400mW
Beyerdynamic				
DT660	32	97	253mV	2mW
DT770, DT880, DT990	250	96	800mV	2,6mW
Grado				
All	32	98	225mV	1,6mW
Koss				
Portapro	60	101	218mV	0,8mW
Sennheiser				
HD500	32	97	253mV	2mW
HD555	120	94	694mV	4mW
HD650	300	97	775mV	2mW
HD800	300	97	775mV	2mW
Ultrasone				
HFI-15G	32	94	716mV	4mW
HFI-550	64	100	252mV	1mW
HFI-700	75	94	548mV	4mW

It can easily be seen that even among the products of one manufacturer there can be huge differences as far as impedance and/or efficiency are concerned. This makes it very important that you either choose headphone and headphone amplifier as a matching combination or go for a headphone amplifier with switchable gain that can be used with a wide variety of headphones. Purchasing the Linear was a perfect step in the right direction.

[3] All figures were taken from freely available data sheets of different manufacturers and have been partly recalculated from other dimensions. Voltage and power are referring to effective values and not to peak values. All figures are given without any guarantee.

Elements at the front section

1 2 3 4

1. Power LED

When this LED lights the Linear is connected to mains voltage switched on and ready for being used.

2. Headphone output 1

6,3mm headphone jack for common headphones. When a headphone is connected to this headphone output the line output at the rear side of the unit will be muted. Warning: when you are also using the line output please make sure that the volume knob is turned to minimum position (counter clockwise) to avoid sudden signal peaks. Please have in mind that the same signal amplitudes can result in very different volume levels connected to power amps or to headphones.

3. Headphone output 2

6,3mm headphone jack for common headphones. When a headphone is connected to this headphone output the line output will *not* be muted. This enables you to listen to headphones and your loudspeakers at the same time
You can connect to headphones of the same type at the same time to the Linear. Please avoid using two different headphones. This may result in very different levels

4. Volume knob

Here you can adjust the desired output level. Turn clockwise to get a higher volume and counter clockwise to lower the volume

W A R N I N G :

While using headphones you can easily reach volume levels that can seriously damage your hearing. Every time before you put on a pair of headphones you must make sure that the volume is set to an appropriate level!

Elements at the rear side

1. Line input (Stereo)

RCA connectors for the source you want to hear with the Linear

2. Line output (Stereo)

RCA connectors for the connection of your power amplifier or active loudspeakers. Depending on which headphone output you are using on the front side of the unit the signal is either fed through the Linear to the line output or muted. The RCA jacks are connected in parallel to the Linear's output stage and not just passively connected to the input connectors so that you benefit greatly when you use the unit as single source preamp.

3. Power switch

This switch separates the primary coil of the power supply transformer from the mains voltage. There is no stand by mode.

4. Fuse holder

Fuse holder for the primary fuse. In case of replacement you must use the same type (100V – 120V AC: 500mA slow or T; 200V – 240V AC 250mA slow or T). If there is a mechanical noise (rattle) when you move the unit the Linear is equipped with a spare fuse which is also placed in the fuse holder.

5. Mains connector

IEC receptable for the connection to mains voltage. Please connect the power cord here. You must make sure that you connect the Linear to the appropriate mains voltage. The mains voltage and fuse type needed are both printed on a sticker underneath the unit.

Adjustment of maximum gain

You can easily adjust the maximum gain of the Linear to use any available headphone with best results independent from efficiency or impedance. The gain setting has direct effect on the active gain of the input stage which is placed after the volume potentiometer. It is recommended that you choose a setting which, at the maximum potentiometer position (turned clockwise), results in a volume level that is slightly higher than your normal listening habit so that you have a bit of reserve with lower level signals. You also make sure that extraordinary high levels can be avoided much easier.

Gain with volume turned to maximum:	Switch 1	Switch 2
0dB	Off	Off
10dB	On	Off
18dB	Off	On
20dB	On	On

The gain setting is done for each channel separately. Please make sure that both channels show the same setting. Otherwise you will hear an abnormally twisted stereo panorama.

Warning: Do not change the gain setting while listening to avoid sudden peaks that might damage your loudspeakers or even your hearing!

Technical Data:

Input impedance:	47kOhm
Maximum gain:	0dB, 10dB, 18dB, 20dB switchable underneath the unit
Frequency response:	10Hz (-0,3dB) - 35kHz (-1dB)
Signal to noise ratio:	>95dB @ Gain 0dB
THD:	<0,001% @ 6mW/300 Ohm
Channel separation:	>70dB/10kHz
Interchannel mismatch:	<0,3dB with volume to maximum
Output power:	300 Ohm /200mW 60 Ohm /400mW
Output impedance:	Line Out 50 Ohms Phones Out 5 Ohms
Connectors audio:	Neutrik headphone jacks (6,35mm) with gold plated contacts. 1x muting (line out) 1x parallel. RCA connectors with gold plated contacts and Teflon isolation
Mains connector:	IEC receptable
Fuse:	100 – 120V AC 500mA slow or T 200 – 240V AC 250mA slow or T
Power consumption:	<10W with internal regulated low noise power supply
Dimensions:	280 x 110 x 44mm (case only)
Weight:	app. 1,5kg

Notes

Manufacturer's address:

Lehmannaudio Vertriebs GmbH
Richard-Zanders-Str. 54
51469 Bergisch Gladbach

Tel.: +49 2202 – 280 62 40
Fax: +49 2202 – 280 62 39
email: info@lehmannaudio.de

Web:
www.lehmannaudio.com
www.headphone-amplifier.com